Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Request for Waiver of Measurement	)	ET Docket No. 04-352
Procedures for OFDM Ultra-Wideband Devices	)	

COMMENTS OF MOTOROLA, INC.

To: Chief, Office of Engineering and Technology

Motorola, Inc. ("Motorola") hereby submits these comments in response to the Petition for Waiver filed by the Multi-band OFDM Alliance Special Interest Group ("MBOA-SIG") regarding certain measurement procedures applicable to multi-band orthogonal frequency division multiplexing ("MB-OFDM") ultra-wideband ("UWB") systems.[1]

For reasons expressed herein, Motorola urges the Commission to deny the requested waiver. MBOA-SIG is not seeking a rules interpretation to confirm that relevant power measurement procedures are not applicable to a specific UWB product design. Rather, they are seeking a *de facto* rule change by asking the Office of Engineering and Technology ("OET") to exempt an entire class of devices from existing Commission rules. The proper vehicle for such regulatory relief is a petition for rulemaking and not waiver.

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[1] *See* Request for Waiver of Measurement Procedures for OFDM Ultrawideband Devices, The Multi-band OFDM Alliance Special Interest Group, filed August 26, 2004 ("*MBOA-SIG Waiver Petition*"). *See also*, Public Notice, ET Docket No. 04-352, released September 3, 2004.

Contrary to MBOA-SIG's contention that it is simply seeking a "level playing field" in the market for UWB devices, FCC approval of this waiver request would provide manufacturers of such technology with a competitive advantage by allowing MB-OFDM devices to operate with as much as 5.88 dB more power than direct sequence UWB devices. The potential effects of such increased power levels threaten incumbent primary services, such as fixed satellite service receivers. Given the likelihood of interference the requested rules changes should not be granted at all and should certainly not be acted on through a generic waiver based on theoretical system designs.

In adopting technical standards for ultra-wideband devices, the Commission intentionally and correctly pursued an approach emphasizing the protection of incumbent services while allowing for the limited introduction of specific UWB designs for specified applications. The Commission subsequently confirmed this approach by deciding that any major changes to its rules should be based on tests conducted with commercially available UWB products. The MBOA-SIG have not submitted any such tests nor have they asked the Commission to consider their request in the context of an application for equipment authorization that describes a product fully consistent with all FCC rules. Thus, grant of the *MBOA-SIG Waiver Petition* is inconsistent with the approach adopted by the Commission. The current rules do not prohibit the development of devices relying on MB-OFDM techniques. The devices can be developed and deployed based on the current rules and at power levels currently authorized to other UWB designs. Accordingly, the Commission should deny the subject waiver request and instead demand that its supporters develop a more sustainable body of empirical evidence

generated through the testing of commercially available products with all of the incumbent spectrum users.

I. Background

The member companies of the MBOA-SIG promote the use of a multi-Band OFDM UWB architecture that features three non-overlapping carriers in one of several band groups operating between 3,432 MHz and 10,296 MHz.[2] According to the description of the technology in the *MBOA-SIG Waiver Petition*, each carrier transmits QPSK-modulated OFDM symbols in a 528 MHz bandwidth to purportedly meet the Commission's minimum UWB bandwidth requirements.[3] As described in the *MBOA-SIG Waiver Petition*, MB-OFDM systems are designed to operate in one of four modes, the simplest of which has digital information transmitted in a time inter-leaved fashion so that every UWB pulse is approximately 240 nanoseconds long with each in-band interval between pulses approximately 700 nanoseconds long.[4] In this mode, the MB-OFDM system transmits data sequentially in each non-overlapping band, repeating the time frequency code sequence until the transmission is complete.

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2 *MBOA-SIG Waiver Petition* at 1.

3 *Id.* at 2.

4 *Id.* The 5.88 dB power advantage over direct sequence UWB devices is based on hopping between the three non overlapping bands with the pulse of 242 nanoseconds on and 695 nanoseconds off, or 10 log((242+695)/242) = 5.88 dB. With a higher ratio of "time off" to "time on", an even greater advantage would be shown.

The issue raised by the *MBOA-SIG Waiver Petition* is the method by which average radiated emissions are to be measured for MB-OFDM systems under the UWB rules. The MBOA-SIG claims that the FCC rules describing the necessary test procedures for power measurements were developed specifically with pulse-based UWB systems in mind and that application to MB-OFDM systems is "less than certain."[5]

Therefore, the MBOA-SIG seeks a waiver of the Commission's frequency hopping measurement procedures to allow MB-OFDM systems to be tested for average emissions under normal operating conditions, rather than with band sequencing stopped.[6] Additionally, MBOA-SIG seeks a waiver of the pulse "gating" procedures set forth in Section 15.521(d) of the rules. Absent these waivers, the MBOA-SIG argues that these policies mean that average power measurements could not factor in the transmission "off" intervals and would therefore require average power levels for MB-OFDM systems to be less than what the UWB rules typically allow.[7] In support of these actions, the MBOA-SIG submits test data which it claims demonstrates that MB-OFDM systems, measured under normal operating conditions, pose no greater threat of harmful interference than pulsed UWB systems permitted by the rules.[8]

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5 *Id.* at 3.

6 *Id.*

7 *Id.* at 4.

8 *Id.* at 8.

II. The Commission Should Deny the *MBOA-SIG Waiver Petition*.

Just over two years ago, the Commission released its initial technical standards for unlicensed UWB devices. That decision was guided by the following underlying philosophy:[9]

> We recognize that the UWB proponents wish to build various types of UWB devices oriented towards the general consumer marketplace. However, we also are concerned about harmful interference absent sufficient constraints. As noted earlier, we believe that a cautious approach is needed during the initial stages of UWB development. For that reason, we are adopting very conservative emission limits for consumer UWB applications for three categories of devices: vehicular radar systems; indoor; and hand-held, short range, peer-to-peer systems.

Less than a year later, the Commission affirmed this approach by noting that:[10]

> [T]his Memorandum Opinion and Order ("MO&O") does not make any significant changes to the existing UWB technical parameters. We are reluctant to do so until we have more experience with UWB devices. We also believe that any major changes to the rules for existing UWB product categories at this early stage would be disruptive to current industry product development efforts. . . . We believe that the next 12 to 18 months should allow the introduction of UWB devices under our recently adopted rules. We also hope that additional tests using commercially available UWB devices will have been completed within that time frame. We understand that such tests currently are being contemplated by the National Aeronautics and Space Administration (NASA), the Department of Transportation (DOT), by the Department of Defense, and by commercial entities. As these steps occur, we intend to continue our review of the UWB standards to determine where additional changes warrant consideration.

The Commission's prognostications proved correct when on August 5, 2004, it issued the first equipment approval for a UWB chip set to Freescale Semiconductor, Inc.

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[9] *In the matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, ET Docket 98-153, *First Report and Order*, FCC 02-48, released April 22, 2002, at ¶62 ["*UWB R&O*"].

[10] *In the matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, ET Docket 98-153, *Memorandum Opinion and Order and Further Notice of Proposed Rule Making*, FCC 03-33, released March 12, 2002, at 1 (*footnotes omitted*) ["*UWB MO&O*"].

("Freescale") – 17 months after the release of the *UWB Memorandum Opinion and Order*.[11]

It is in this context that the instant waiver request must be reviewed. Without additional testing completed by the National Telecommunications and Information Administration ("NTIA"), Department of Defense ("DOD") or the FCC, the MBOA-SIG seeks additional flexibility to deploy technologies with higher power than permitted under the rules. In Motorola's view, such a request is not timely and is inconsistent with the approach adopted by the Commission in the UWB proceeding.

More importantly, grant of this request has the potential to increase interference to primary spectrum users. Given that the development and deployment of MB-OFDM technology ***is not*** dependent on the grant of this waiver request, the Bureau should reject the waiver route and only consider further refinements in its measurement procedures via rulemakings based on independent test data and real world product performance.

A. Grant of the *MBOA-SIG Waiver Petition* Would Raise the Risk of Potential Interference.

In simple terms, the *MBOA-SIG Waiver Petition* is seeking the ability to perform required equipment certification measurements with the multi-frequency band devices operating in a normal mode, *i.e.*, with the frequency hopping mode enabled. This requires waiver of Section 15.31(c) of the Commission's rules, which the staff has interpreted as requiring the average emissions from frequency hopping systems be measured with the frequency hopping function disabled. It also requires waiver of

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[11] *Freescale Receives First FCC Certification For Ultra-Wideband Technology*, News Release (August 9, 2004). *Available at* http://www.freescale.com/webapp/sps/site/display.jsp?nodeId=093623&filePath=/media_center/news_releases/2004/wmsg/08-09-04_1ST_FCC_CERT_FOR_UWB.htm&title=News%20Release

Section 15.521(d) of the Commission's UWB rules, which states "if pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on." Essentially, this requirement would have the same effect as the staff interpretation of Section 15.31; namely, it would require emissions measurements based on a single transmission pulse.

The *MBOA-SIG Waiver Petition* argues that Section 15.521(d) should not apply to MB-OFDM UWB devices because the QPSK-modulated OFDM pulse train in each band is never gated on or off.[12] The MBOA-SIG argues that since there is no "quiescent period" when the waveform in the band is gated off, it is impossible to determine whether the pulse repetitions are comparatively short or long in order to determine the transmissions applicability to Section 15.521(d).[13]

Motorola believes that this analysis is placing form over substance. Even if MB-OFDM transmissions do not fully conform with previous staff determinations on the nature of "gated" waveforms, the effects remain the same. Allowing the frequency hopping function to be enabled during power measurements will allow time averaging effects to greatly understate the energy contained within each individual pulse. In similar circumstances, the Commission indicated that it clearly understands the issue associated with measuring frequency hopping UWB systems and decided to proceed cautiously. In its *UWB MO&O* released only last year, the Commission indicated:[14]

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12 *MBOA-SIG Waiver Petition* at 8.

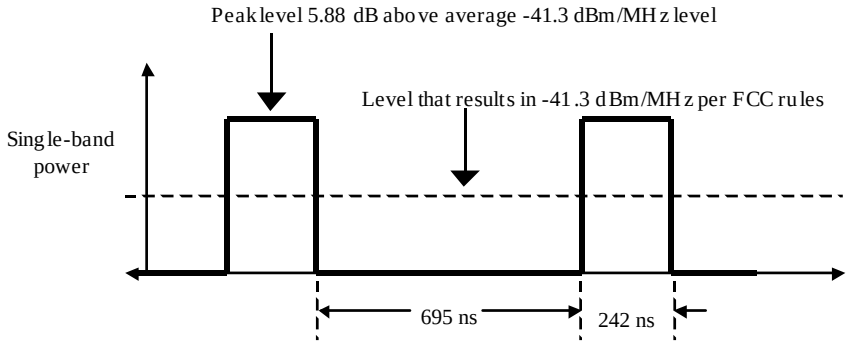
13 *Id*.

14 *UWB MO&O* ¶45 [*footnote omitted, emphasis added*].

> In the *R&O*, the Commission specifically precluded the operation of swept frequency systems and frequency hopping systems under the UWB rules unless the transmissions comply with the minimum bandwidth requirement when measured with the sweep or hopping sequence stopped. ***The Commission indicated that this was necessary as no measurement procedure had been established to permit the emission levels from such devices to be determined while sweeping or hopping***.

Given that there are no established measurement procedures for MB-OFDM devices recognized by any international standards setting group, the Commission should maintain a similar conservative approach and require such devices to demonstrate compliance in the same manner as other UWB devices.

While the *MBOA-SIG Waiver Petition* claims to be attempting to create a level playing field, it is in fact seeking to create a 5.88 ***dB competitive advantage*** over other UWB designs as shown below:



Motorola believes that, under the Commission's conservative approach toward UWB technical standards, the OET must consider the time interval between in-band pulses as the quiescent period and therefore apply the provisions of Section 15.521(d) to MB-OFDM devices. Otherwise, the FCC risks creating an unintentional "across-the-board" power increase for UWB devices.

At a minimum, for the rules to be changed as requested by the MBOA-SIG, they must demonstrate that they do not cause any additional interference to primary receivers. However, the testing presented by the *MBOA-SIG Waiver Petition* is neither accurate nor vigorous. Both NTIA ITS labs and the FCC are conducting testing of various UWB devices to determine the relative interference potential. There is no reason to act on a waiver request without full development of the record with respect to testing and interference.

The FCC's UWB rules and test procedures were developed after considerable testing and thought given to interference concerns during a multi-year rule making. The Commission specifically adopted what it considered a conservative approach and indicated that it would only revisit the limits as additional information were received that would justify a relaxation of the limits. The situation since the Commission's decision has not materially changed. It is inappropriate for the Commission to deviate from its carefully balanced decision via a waiver. Changes to the Commission's rules should only be conducted via the rule making process that will provide adequate rigor and participation to ensure protection of primary services.

B. The Commission Should Not Consider Waiver in the General Case.

The Commission is within its rules to consider alternative measurement requirements in the context of specific applications for equipment authorization. *See* 47 C.F.R. §15.521(d). Considering the implications of its rules with regard to a specific design is preferable because the staff can consider the totality of the design and make better assessments of interference potential.

Granting waivers to theoretical product designs, as submitted here, is not sound practice. Indeed, the MB-OFDM waveform continues to be refined such that applications for equipment authorization may specify designs dissimilar from that disclosed in this proceeding.

To this end, the Commission must look closely at the waveform proposed by the MBOA-SIG, since it is not clear that it meets the FCC's minimum 500 MHz bandwidth requirement. If true, OET should not further consider this request and should reject the waiver immediately. There is no need to rule on the measurement techniques for a UWB design that does not otherwise satisfy the FCC's UWB technical requirements.

As indicated in the *MBOA-SIG Waiver Petition*, the MB-OFDM signal is made up of 122 sub carriers that are each 4.125 MHz wide. Of these sub carriers, 100 are data sub carriers, 12 are pilot carriers, and 10 are guard carriers.[15] The guard sub carriers are described as follows:

> The guard sub carriers can be used for various purposes, including relaxing the specs on transmit and receive filters. The magnitude level of the guard tones is not specified other than the definition below, and implementations can use reduced power for these sub carriers if desired.

This would imply that the power could be reduced to zero since they have no intention of decoding these carriers to capture any information. Since the guard sub carriers carry no information and can be turned completely off, the actual required bandwidth of the MB-OFDM waveform is only 112 times 4.125 MHz, which equals 462 MHz. Since this does not satisfy the 500 MHz minimum bandwidth requirement in the FCC rules, the MB-OFDM waveform should be handled as a frequency swept signal

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[15] *MBOA-SIG Waiver Petition*, Attachment B at 7.

where the frequency sweep is required to obtain a waveform that is at least 500 MHz wide. Under FCC rules, the measurement procedures for swept frequency devices are to be made with the frequency sweep stopped.[16] The Commission established this policy because "no measurement procedures have been proposed or established for swept frequency devices nor has the interference aspects of swept frequency devices been evaluated based on the different measurement results that would be obtained from measurements taken with the sweep active."[17] This policy should equally apply to MB-OFDM devices as well.

Recently, NTIA raised concerns about such approaches, commenting specifically on the possibility that manufacturers would intentionally add noise to a signal in order to meet the minimum UWB 500 MHz bandwidth requirements. In a letter submitted to the FCC earlier this year, NTIA expressed its belief that "the intentional addition of unnecessary noise to a signal would violate the Commission's long-standing rules that devices be constructed in accordance with good engineering design and manufacturing practice."[18] NTIA concluded that "a device where noise is intentionally injected into the signal should never be certified by the Commission."[19]

Motorola agrees with the NTIA's recommendations. While this does not mean that all MB-OFDM designs do not comport with the FCC's UWB standards, it does highlight the inappropriateness of proceeding to waive the rules based on this general

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16 *See* Section 15.31(c) of the Commission's Rules.

17 *UWB R&O* at ¶32.

18 Comments of the National Telecommunciations and Information Administration, ET Docket No. 98-153, January 15, 2004, at 23.

19 *Id* at 24.

request. It is not entirely clear what products the waiver request would apply and under what operating modes. Given that UWB technologies are clearly in the nascent stage of development it is inappropriate to give a unique technology design a "blank check" in the form of regulatory relief that promises to increase operational power by as much as 5.88 dB. Again, the relief sought by the *MBOA-SIG Waiver Petition* is more appropriately considered in a petition for rule making and only after additional tests are completed by independent agencies.

It is important for OET to remember that denial of the requested waiver will not prevent development or deployment of MB-OFDM technology. The existing rules do not prohibit the technology being considered; the issue is only how the average power is measured. MB-OFDM technology can be approved, with measurements based on average power with the pulse train gated on. This will result in the system operating at power levels comparable to those permitted by the FCC rules and adhered to by direct sequence UWB systems. Under this scenario, neither technology achieves a competitive advantage through regulatory interpretations.

III. Conclusion.

The *MBOA-SIG Waiver Petition* is not about regulatory parity. It is an attempt to get a competitive marketplace advantage by allowing higher-powered devices than currently permitted. This is not consistent with the Commission's conservative approach to establishing and enforcing its initial technical standards for ultra-wideband devices. While measurement procedures are appropriate for further review, the Commission should dismiss this instant waiver request and instead invite MB-OFDM proponents to work with the NTIA and OET staffs to develop additional testing procedures based on

actual product designs that could ultimately lead to changes in the Part 15 rules. While, this approach does not disadvantage MB-OFDM manufacturers as they proceed with product developments under the existing rules, it provides primary spectrum users with the protection and consideration established by the Commission throughout the UWB proceeding.

Respectfully submitted,

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September 29, 2004